Exploring habitat loss and fragmentation in amenity landscapes through agent-based landuse modelling

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Thanks to the PhD collaborative travel grant offered to me by the Terrestrial Biodiversity Network of NCCARF, I was able to travel to Canada to meet up and collaborate with Dr. Dawn Parker of the University of Waterloo, Canada.

My PhD research aims to: 1) develop an agent-based land use model for amenity landscapes, 2) calibrate and validate the model, and 3) use the model as a decision support system for natural resource managers to achieve a balance between landscape change and biodiversity conservation under climate change.

Major findings and outcomes of the collaboration
I discussed the conceptual design of the agent-based model developed for this PhD project with Dr. Dawn Parker, who is an expert in agent-based land use modelling, in order to identify strong points, weak points and further improvements. She suggested several conceptual and implementation strategies which could be incorporated into the proposed model for my project. For example, land ownership change is an essential element that should be modelled, and Dr. Parker's research has investigated land market modelling with agents in detail. She explained how I should conceptualize and implement land tenure transfer, and even pointed me to relevant sources of programming code to help me get started. She also provided valuable material and directions that I later used to further develop a land subdivision automation, as a part of the large agent-based model. During this visit, I was also fortunate to meet a group of visiting agent-based modellers from Europe and USA. I took the opportunity to further discuss my model with them and get their feedback. Implementing agents' decision making properly is vital in any agent-based model. Those researchers discussed many available decision making modules with me, and suggested how I could go step-by-step starting from the simplest decision making module in my model. I attended a presentation session where those modellers presented an array of agent-based models they have developed for various applications. I learnt a lot about effectively communicating agent-based research, and how one should use agent-based modelling in scientific research.

Outcomes of Collaboration
I improved my knowledgebase about agent-based modelling vastly thanks to this collaboration opportunity. The conceptual model of my agent-based model became much better, and implementation became easier following this visit. I have now completed coding for the first prototype of the agent-based model for amenity landscapes. The guidance received from Dr. Parker and the other agent-based modellers I met in Canada was very helpful in achieving this major success in my PhD research. Findings of the research so far are expected to be published soon in a series of journal papers.

Significance to Adapting and Protecting Australia's Terrestrial Biodiversity
My research focuses on agent-based modelling of habitat loss and fragmentation in amenity landscapes of Australia. Rural farmlands in Australia are unique landscapes which host significant amounts of biodiversity. However, amenity migration (movement of people from

urban to rural areas in search of lifestyle change) affects the ability of these landscapes to sustain biodiversity. When combined with effects from a changing climate (such as more frequent drought and bushfires predicted for rural New South Wales), amenity migration may cause irreversible loss of biodiversity. Therefore, accommodating changes induced by amenity migration under a changing climate while conserving biodiversity is quite challenging. Spatial decision support tools can help unravel the complex spatio-temporal relationships that affect landscape response to change from amenity migration and climate. In particular, agent-based land use models have proven effective in simulating such complex dynamics through modelling the decisions and activities of many single actors, and interactions among them and their environment.

This collaboration enabled me to come up with a quality agent-based model that could be used by scientists and planners to better understand the dynamics in amenity landscapes, and possibly to find avenues to accommodate inevitable changes undergoing in the landscape with the least possible impact on biodiversity.